

MONOLITHIC CERAMIC CAPACITORS

CATALOG NO. 59-01A



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MURATA ERIE NORTH AMERICA, INC.

MURATA ERIE...

is the world's largest manufacturer of ceramic capacitors with an unexcelled reputation for quality based on 36 years of experience.



Worldwide Corporate Headquarters
Kyoto, Japan



Integrated U.S. Monolithic Capacitor Production Facilities
State College, Pennsylvania



Monolithic Ceramic Capacitor Production Facility
Fukui, Japan

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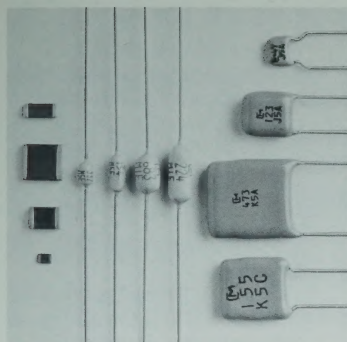
NOTE: All specifications are subject to change without notice.

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THE MONOLITHIC CERAMIC CAPACITOR...



By MURATA ERIE NORTH AMERICA INC.



Multi-layer monolithic ceramic capacitors represent the current state-of-the-art for providing high capacitance per unit volume in a variety of readily available form factors.

Radial and axial leaded devices are compatible with the high speed automatic insertion equipment used in the assembly of printed circuit boards. Unleaded, unencapsulated chip capacitors are also available in tape and reel packaging for high speed automatic placement in hybrid and printed circuit board assemblies.

All monolithic ceramic capacitor form factors begin as a basic chip which consists of alternating layers of ceramic dielectric on which electrodes are printed. The stacked layers are sintered (fired) at very high temperatures to form a single monolithic device. Internal, alternate electrode layers are connected thru common end terminations to form the basic chip capacitor. Leads may be attached in radial or axial form to the chip end termination. The bare leaded chip is then encapsulated with an epoxy compound.

Ceramic dielectric materials of various formulations are available with the most common being NPO (COG), X7R and Z5U.

NPO dielectric formulation is a temperature stable material which exhibits negligible capacitance change with temperature. The material exhibits a low dissipation factor (high Quality factor) and is ideally suited for higher frequency use. Applications include tuned circuitry, timing circuits and medical electronics where long term stability is required.

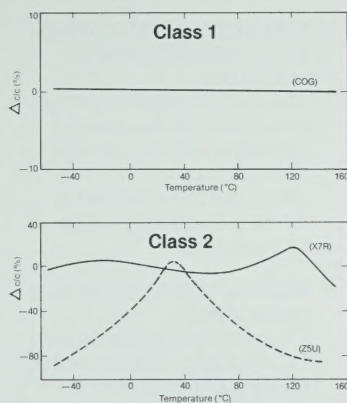
X7R dielectric formulation is a volumetrically efficient material which exhibits moderate capacitance change over a wide range of temperature, frequency and voltage conditions. Applications include coupling, filtering and bypassing in a variety of electronic circuitry.

Z5U/Y5V dielectric formulation offers the maximum capacitance per unit volume with a capacitance vs temperature characteristic that varies widely. Most common applications are for coupling and bypass use.

Murata Erie North America's State College facility represents the state-of-the-art in volume manufacture of leaded and chip multi-layer ceramic capacitors. Features of all Murata Erie multi-layer ceramic capacitor facilities include:

- highly automated manufacturing process
- class 10,000 or better clean room front end operations
- 100% electrical testing for all components
- continuous QC inspection and audits of all materials and processes
- complete test facilities (DPA, various scanning techniques, etc)

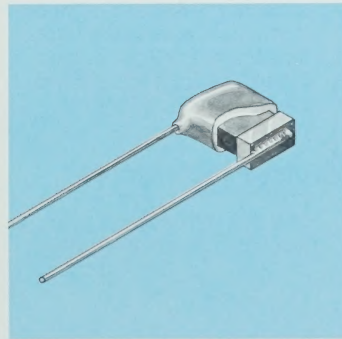
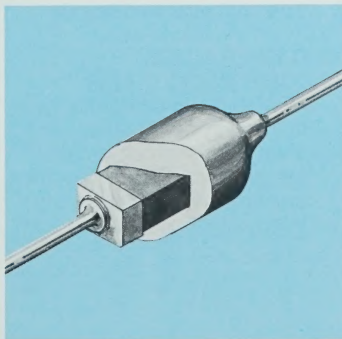
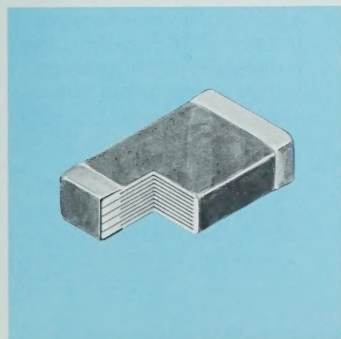
typical capacitance vs. temperature



Our manufacturing facilities lend themselves ideally to the production of the highest quality multi-layer ceramic capacitors in the world. This factor has led to our acceptance as a "parts per million" (ppm) supplier by a number of our valued customers.

Murata Erie's comprehensive line of monolithic ceramic capacitors represented in this catalog, can meet virtually every application requirement. In addition to the standard NPO, X7R and Z5U dielectric formulations, a wide range of temperature compensating and high "K" dielectric units are also available.

If a device to meet a specific requirement is not illustrated in this catalog, contact Murata Erie's nearest sales office. Our application and customer engineering personnel stand ready to help!



GLOSSARY OF SPECIALIZED CAPACITOR TERMS

1. CAPACITANCE:

Is defined as the property of a system of conductors and dielectrics that permits the storage of separated electric charges when potential differences exist across the conductors.

2. MONOLITHIC OR MULTI-LAYER CAPACITOR: (CHIP/RADIAL/AXIAL)

All of these terms, and any combination of them, refer to a ceramic capacitor style which consists of alternate layers of ceramics and conductive (metallic) surfaces which are compressed and vitrified to form a single "monolithic" structure. Alternate metallic surfaces are then interconnected to form a two terminal capacitor.

3. TOLERANCE OF CAPACITANCE:

Is defined as the maximum percentage of deviation from the nominal capacitance value when measured at a standard temperature, voltage and frequency.

4. DIELECTRIC:

Sometimes called "Insulator," a dielectric is a material whose internal charges are bound and can therefore only move over atomic dimensions. It separates the conductive capacitor plates and is important in determining temperature characteristics, voltage rating, capacity/volume and other characteristics of a capacitor.

5. DISSIPATION FACTOR ("DF"):

The dissipation factor of an insulating material is defined

as the ratio of energy dissipated to energy stored in the dielectric. The DF is frequency sensitive and must be specified at a specific frequency.

6. QUALITY FACTOR ("Q"):

The Q factor is the ratio of energy stored to energy dissipated and is therefore often taken as the inverse of the DF at low frequency. Sometimes called "Figure of Merit," Q factors must be specified at a specific frequency.

7. WORKING (OR "RATED") VOLTAGE:

Nominal continuous voltage which may be applied to a component with no derating of any kind.

8. DIELECTRIC WITHSTANDING ("BREAKDOWN") VOLTAGE:

The peak voltage which the component is designed to withstand without damage for short periods of time. This value must be specified in terms of frequency, waveform, and time.

9. INSULATION RESISTANCE (MEGOHMS):

I.R. is the terminal to terminal DC resistance of a capacitor, and must be specified in terms of voltage, temperature, and relative humidity.

10. TEMPERATURE COEFFICIENT ("TC"):

"TC" is the decimal change in capacity per degree change in environmental temperature. Some dielectrics are very lossy and generate internal heat and for that

reason this test is conventionally conducted under "no load" conditions. The standard definition for "TC" in parts per million per degree centigrade is...

$$TC = \frac{(Cx - Co)}{Co} \times \frac{(10^6)}{(Tx - To)} / ^\circ C$$

Where "Tx" is the test temperature, "To" is the reference temperature—usually 25°C. "Co" is the capacity measured at the reference temperature and "Cx" is the capacity measured at the test temperature.

11. DRIFT:

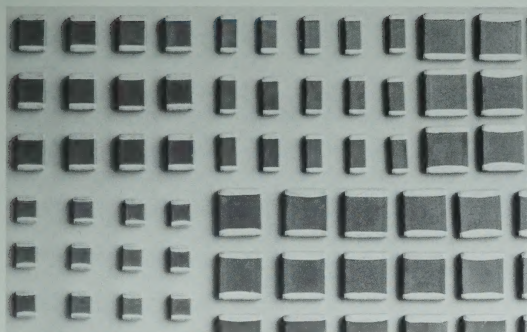
The extent in pF or % to which the capacitor changes value as a result of temperature exposure. Sometimes called "Retrace," this measurement is usually made under nominal (i.e. room) conditions and is accomplished both before and after the conclusion of temperature excursion. (Note: "Drift" may occasionally be used in the test context of the simple passage of time).

12. VOLTAGE COEFFICIENT:

All high K dielectrics tend to reduce their dielectric coefficient (capacity) in the presence of strong unidirectional electric fields. For some materials, and package designs, this effect can become very dramatic. Lower K materials do not exhibit a similar phenomenon. (Usually specified in pF/volt).

13. TERMINATION:

This term refers to the material and/or geometry of the terminals of the capacitor.



FEATURES

- Miniature size
- Wide capacitance, TC, voltage and tolerance range
- Industry standard sizes
- 8 mm and 12 mm tape & reel for auto placement
- Three end termination systems available for wave, reflow or vapor phase solder
- Largest production volume and capacity in the industry

PART NUMBERING

TYPE	TEMP. CHAR.	CAPACITANCE	TOLERANCE	VOLTAGE	PACKAGING
GR 40	X7R	103	K	50V	PT
CAPACITOR TYPE AND SIZE GR=Silver-plated terminal. Solder coated and nickel protected terminations are available. See Notes Below.	TEMPERATURE CHARACTERISTICS Standard TC's (described herein) COG=0, ± 30 ppm (Note 1), -55°C to $+125^{\circ}\text{C}$ X7R= $\pm 15\%$, -55°C to $+125^{\circ}\text{C}$ Z5U= $\pm 22\%$, -56% , $+10^{\circ}\text{C}$ to $+85^{\circ}\text{C}$ Y5V= $\pm 22\%$, -82% , -30°C to $+85^{\circ}\text{C}$ Additional TC's Available Upon Request (Contact Factory)	CAPACITANCE VALUE Expressed in picofarads and identified by a three-digit number. First two digits represent significant figures. Last digit specifies the number of zeros to follow. For values below 10pF, the letter "R" is used as the decimal point and the last digit becomes significant.	CAPACITANCE TOLERANCE (Note 2) COG: (10pF or less) C= $\pm 25\text{pF}$ D= $\pm 5\text{pF}$ F= $\pm 1\text{pF}$ (over 10pF) G= $\pm 2\%$ J= $\pm 5\%$ K= $\pm 10\%$ X7R: K= $\pm 10\%$ M= $\pm 20\%$ (J= $\pm 5\%$ on special request) Z5U: M= $\pm 20\%$ Z= $\pm 80\%$, -20% Y5V: Z= $\pm 80\%$, -20%	VOLTAGE Identified by a two or three digit number. 500V available upon request	PT=Tape Carrier PB=Bulk

NOTES: T.C. Tolerance (COG)

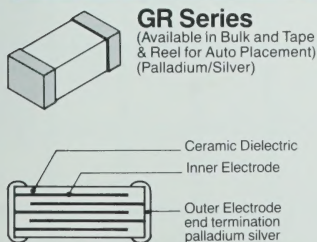
1. Capacitance (pF)	T.C. Tolerance (ppm)
.4-2.0	± 250 (K)
2.1-3.9	± 120 (J)
4.0-9.9	± 60 (H)
10 or over	± 30 (G)

Refer to EIA RS198 for limitations

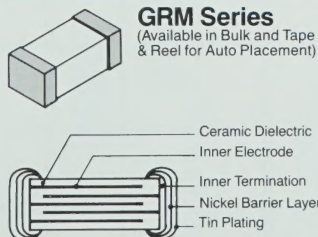
2. F= $\pm 1\%$ available on special order in COG types GR 42-2, GR 43, GR 43-2 and GR 44-1.

CHIP TERMINATION DIAGRAMS

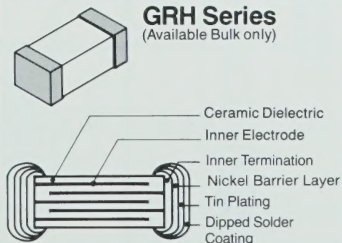
Standard



Barrier Layer



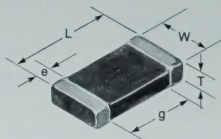
Solder Coated



NOTE: Other Terminations Available Upon Request (Contact Factory)

CHIPS-COG (NPO) GR Series

DIMENSIONS in:(mm)



TYPE AND SIZE	GR 39			GR 40			GR 40-1			GR 42-6		
VOLTAGE	50V	100V	200V	50V	100V	200V	50V	100V	200V	50V	100V	200V
CAPACITANCE (pF)												
0.5	(0.5)	(0.5)		(0.5)	(0.5)	(0.5)	(0.5)	(0.5)		(0.5)	(0.5)	(0.5)
10			NOT						NOT			
12												
15												
18			AV						AV			
22			A						A			
27			I						I			
33			L						L			
39			A						A			
47			B						B			
51			L			(51)			L			
56			E						E			
68												
82												
100		(82)										
120												
130	(120)											
150												
180												
220												
240												(240)
270												
330												
360												
390												
430												
470								(430)				
510												
560												
620												
680												
820				(750)								
910												
1,000												
1,100												
1,200								(1,100)			(1,100)	
1,500												
1,600												
1,800												
2,200										(2,000)		
2,400												
2,700												
3,000												
3,600												
3,900												
4,700												
5,100												
5,600												
6,800												
8,200												
(μF) 01												

Capacitance tolerance: G = ± 2%, J = ± 5%, K = ± 10%, (F = ± 1%; 10pF and higher, available on special request).

*Standard EIA values between 0.5pF and 10pF are available. Available in GR, GRM, GRH series.

Also ideal for hybrid applications using reflow soldering method.

DIMENSIONS in:(mm)

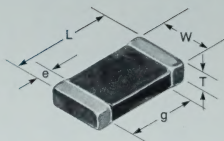
Murata Erie Designation	GR39	GR40	GR40-1	GR42-6	GR42-2	GR41	GR43	GR43-2	GR44-1
EIA Designation		CC 0805	CC 1005	CC 1206	CC 1210	CC 1805	CC 1808	CC 1812	
L	.060±.012 (1.5±0.3)	.080±.012 (2.0±0.3)	.100±.012 (2.5±0.3)	.125±.010 (3.2±0.25)	.125±.016 (3.2±0.4)	.180±.020 (4.6±0.5)	.180±.020 (4.6±0.5)	.180±.020 (4.6±0.5)	.220±.020 (5.6±0.5)
W	.030±.012 (0.8±0.2)	.050±.012 (1.25±0.3)	.050±.012 (1.25±0.3)	.060±.010 (1.5±0.25)	.100±.012 (2.5±0.3)	.050±.012 (1.25±0.3)	.080±.012 (2.00±0.3)	.125±.016 (3.2±0.4)	.200±.020 (5.1±0.5)
T (max)	.040 (1.0)	.050 (1.25)	.050 (1.25)	.050 (1.25)	.060 (1.5)	.050 (1.25)	.060 (1.5)	.080 (2.0)	.080 (2.0)
g (min)	.012 (0.3)	.030 (0.7)	.030 (0.7)	.040 (1.0)	.040 (1.0)	.080 (2.0)	.080 (2.0)	.080 (2.0)	.080 (2.0)
e (min)	.008 (0.2)	.010 (0.25)	.010 (0.25)	.010 (0.25)	.012 (0.3)	.012 (0.3)	.012 (0.3)	.012 (0.3)	.012 (0.3)

GR 42-2			GR 41			GR 43			GR 43-2			GR 44-1		
50V	100V	200V	50V	100V	200V	50V	100V	200V	50V	100V	200V	50V	100V	200V
			(15)	(15)	(15)									
		(56)												
					(130)			(150)						
	(430)	(360)						(430)				(470)		
(820)												(820)		
				(1,000)										(910)
			(1,500)			(1,600)	(1,200)							
	(2,200)						(2,400)							(2,200)
(3,600)						(3,600)			(3,900)	(2,700)				
									(4,700)	(3,900)		(5,100)	(4,700)	

*Standard EIA values between 0.5pF and 10pF are available.

	(.01)	(.01)
--	-------	-------

DIMENSIONS in:(mm)



TYPE AND SIZE	GR 39			GR 40			GR 40-1			GR 42-6		
VOLTAGE	25V	50V	100V	25V	50V	100V	25V	50V	100V	25V	50V	100V
CAPACITANCE												
(pF) 220	(220)	(220)	(220)		(220)	(220)		(220)	(220)		(220)	(220)
270												
330												
390												
470												
560												
680												
820												
1,000												
1,200												
1,500												
1,800												
2,200												
2,700			(2,700)									
3,300												
3,900												
4,700		(3,900)										
5,600	(4,700)											
6,800												
8,200				(.01)								
(μF) .01												
.012												
.015												
.018												
.022						(.012)			(.012)	(.018)		
.027					(.022)							(.022)
.033				(.033)			(.039)					
.039							(.047)	(.033)			(.047)	
.047												
.056												
.068												
.082												
.10												
.12												
.15										(.10)		
.18												
.22												
.27												
.33												
.39												
.47												
.56												

Capacitance tolerance: K = $\pm 10\%$, M = $\pm 20\%$, (J = $\pm 5\%$ on special order)

Available in GR, GRM, GRH series.

Also ideal for hybrid applications using reflow soldering method.

DIMENSIONS in:(mm)

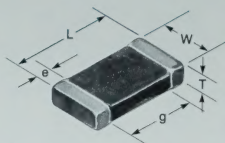
Murata Erie Designation	GR39	GR40	GR40-1	GR42-6	GR42-2	GR41	GR43	GR43-2	GR44-1
EIA Designation		CC 0805	CC 1005	CC 1206	CC 1210	CC 1805	CC 1808	CC 1812	
L	.060±.012 (1.5±0.3)	.080±.012 (2.0±0.3)	.100±.012 (2.5±0.3)	.125±.010 (3.2±0.25)	.125±.016 (3.2±0.4)	.180±.020 (4.6±0.5)	.180±.020 (4.6±0.5)	.180±.020 (4.6±0.5)	.220±.020 (5.6±0.5)
W	.030±.012 (0.8±0.2)	.050±.012 (1.25±0.3)	.050±.012 (1.25±0.3)	.060±.010 (1.5±0.25)	.100±.012 (2.5±0.3)	.050±.012 (1.25±0.3)	.080±.012 (2.00±0.3)	.125±.016 (3.2±0.4)	.200±.020 (5.1±0.5)
T (max)	.040 (1.0)	.050 (1.25)	.050 (1.25)	.050 (1.25)	.060 (1.5)	.050 (1.25)	.060 (1.5)	.080 (2.0)	.080 (2.0)
g (min)	.012 (0.3)	.030 (0.7)	.030 (0.7)	.040 (1.0)	.040 (1.0)	.080 (2.0)	.080 (2.0)	.080 (2.0)	.080 (2.0)
e (min)	.008 (0.2)	.010 (0.25)	.010 (0.25)	.010 (0.25)	.012 (0.3)	.012 (0.3)	.012 (0.3)	.012 (0.3)	.012 (0.3)

[illegible]

Capacitance tolerance: K = $\pm 10\%$, M = $\pm 20\%$, (J = $\pm 5\%$ on special order)

(.56)

DIMENSIONS in:(mm)



TYPE AND SIZE	GR 39		GR 40		GR 40-1		GR 42-6		GR 42-2		GR 41		GR 43		GR 43-2		GR 44-1	
VOLTAGE	50V	100V	50V	100V	50V	100V	50V	100V	50V	100V	50V	100V	50V	100V	50V	100V	50V	100V
CAPACITANCE																		
(pF)																		
1,000	(1,000)	(1,000)	(1,000)	(1,000)	(1,000)	(1,000)	(1,000)	(1,000)										
1,500																		
2,200																		
3,300												(3,300)						
4,700		(3,300)										(4,700)						
(μF)																		
6,800																		
.010	(.010)																	
.015				(.015)		(.015)												
.022									(.022)									
.033							(.033)				(.033)							
.047													(.047)					
.068			(.068)		(.068)				(.068)				(.10)					
.10									(.10)									
.15							(.15)								(.15)			
.22											(.22)						(.22)	
.33									(.33)				(.33)					(.39)
.47												(.47)						
.68													(.68)	(.68)				
1.0																(1.0)		
1.5																(1.5)		

Available in GR, GRM, GRH series.

Also ideal for hybrid applications using reflow soldering method.

Capacitance tolerance: M = $\pm 20\%$, Z = $+ 80\%$, -20%

DIMENSIONS in:(mm)

Murata Erie Designation	GR39	GR40	GR40-1	GR42-6	GR42-2	GR41	GR43	GR43-2	GR44-1
EIA Designation		CC 0805	CC 1005	CC 1206	CC 1210	CC 1805	CC 1808	CC 1812	
L	.060 ± .012 (1.5 ± 0.3)	.080 ± .012 (2.0 ± 0.3)	.100 ± .012 (2.5 ± 0.3)	.125 ± .010 (3.2 ± 0.25)	.125 ± .016 (3.2 ± 0.4)	.180 ± .020 (4.6 ± 0.5)	.180 ± .020 (4.6 ± 0.5)	.180 ± .020 (4.6 ± 0.5)	.220 ± .020 (5.6 ± 0.5)
W	.030 ± .012 (0.8 ± 0.2)	.050 ± .012 (1.25 ± 0.3)	.050 ± .012 (1.25 ± 0.3)	.060 ± .010 (1.5 ± 0.25)	.100 ± .012 (2.5 ± 0.3)	.050 ± .012 (1.25 ± 0.3)	.080 ± .012 (2.00 ± 0.3)	.125 ± .016 (3.2 ± 0.4)	.200 ± .020 (5.1 ± 0.5)
T (max)	.040 (1.0)	.050 (1.25)	.050 (1.25)	.050 (1.25)	.060 (1.5)	.050 (1.25)	.060 (1.5)	.080 (2.0)	.080 (2.0)
g (min)	.012 (0.3)	.030 (0.7)	.030 (0.7)	.040 (1.0)	.040 (1.0)	.080 (2.0)	.080 (2.0)	.080 (2.0)	.080 (2.0)
e (min)	.008 (0.2)	.010 (0.25)	.010 (0.25)	.010 (0.25)	.012 (0.3)	.012 (0.3)	.012 (0.3)	.012 (0.3)	.012 (0.3)

TYPE AND SIZE	GR 39		GR 40		GR 40-1		GR 42-6		GR 42-2		GR 41		GR 43		GR 43-2		GR 44-1	
VOLTAGE	25V	50V	25V	50V	25V	50V	25V	50V	25V	50V	25V	50V	25V	50V	25V	50V	25V	50V
CAPACITANCE																		
(pF) 1,000	(1,000)	(1,000)		(1,000)		(1,000)		(1,000)										
1,500																		
2,200			(2,200)		(2,200)							(2,200)						
3,300												(3,300)						
4,700																		
(μF) 6,800																		
.01		(.01)																
.015	(.015)																	
.022																		
.033																		
.047																		
.068							(.068)											
.10			(.10)		(.10)				(.15)		(.1)							
.15												(.15)						
.22								(.22)				(.22)			(.22)			
.33							(.33)						(.33)					
.47									(.33)					(.47)				
.68										(.68)			(.68)		(.82)	(.68)	(.82)	
1.0													(.68)		(.82)		(1.0)	(.82)
1.5																(1.5)	(1.5)	

Capacitance tolerance: Z = + 80%, -20%

8mm to EIA RS481 Cardboard Tape

DIMENSIONS in: (mm)



Reel Cavity Dimensions

TYPE	A	B
GR40	.065 (1.65)	.094 (2.4)
GR42-6	.079 (2.0)	.142 (3.6)
GR42-2	.114 (2.9)	.146 (3.7)

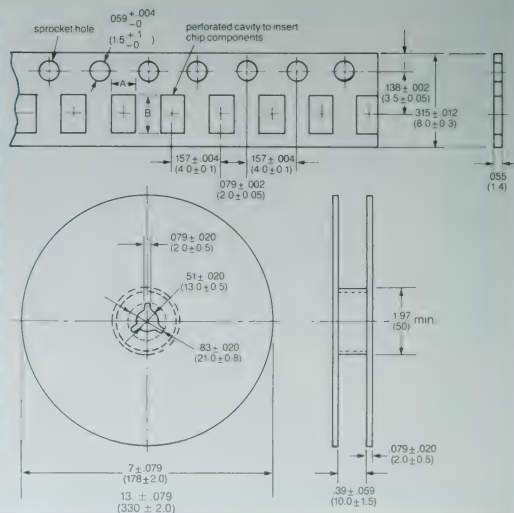
	GR40	GR42-6	GR42-2
L	.080 \pm .012 (2.0 \pm 0.3)	.125 \pm .010 (3.2 \pm 0.25)	.125 \pm .016 (3.2 \pm 0.4)
W	.050 \pm .012 (1.25 \pm 0.3)	.060 \pm .010 (1.5 \pm 0.25)	.100 \pm .012 (2.5 \pm 0.3)
T (max)	.040 (1.0)	.050 (1.25)	.050 (1.25)
g (min)	.03 (0.7)	.04 (1.0)	.04 (1.0)
e (min)	.01 (0.25)	.01 (0.25)	.012 (0.3)

Standard quantities per reel are:

TYPE & SIZE	Reel Size 7 ± .079 (178 ± 2.0) Quantity per Reel	Reel Size 13 ± .079 (330 ± 2.0) Quantity per Reel
• GR40 • GR708	4,000 pcs. max.	10,000 pcs. max.
• GR42-6	4,000 pcs. max.	10,000 pcs. max.
• GR42-2 • GR710	4,000 pcs. max.	10,000 pcs. max.

*: GR708/GR710 are Hi-Q Chip capacitors

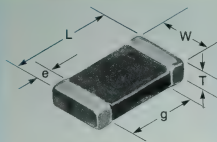
** : Available in embossed tape



CAPACITANCE RANGE—8mm TAPE & REEL

TEMP. CHAR.	C0G						X7R						Y5V						Z5U									
TYPE AND SIZE	GR40		GR42-6		GR42-2		GR40			GR42-6			GR42-2			GR40		GR42-6		GR42-2		GR40		GR42-6		GR42-2		
VOLTAGE	50V	100V	50V	100V	50V	100V	25V	50V	100V	25V	50V	100V	25V	50V	100V	25V	50V	25V	50V	25V	50V	50V	100V	50V	100V	50V	100V	
CAPACITANCE																												
(pF) 0.5	(0.5)	(0.5)	(0.5)	(0.5)																								
10																												
100																												
1,000	(510)	(360)			(560)	(390)		(220)	(220)		(220)	(220)																
(μF) 0.1			(2,000)	(1,500)	(2,700)	(2,000)			(7,500)				(8,200)			(2,200)	(1,000)	(1,000)				(1,000)	(1,000)	(1,000)	(1,000)	(1,000)	(1,000)	
1							(0.22)	(0.15)		(0.18)		(0.22)	(0.27)	(0.18)			(0.47)	(0.56)		(0.68)	(0.39)		(0.33)	(0.47)	(0.33)		(0.15)	
10																		(0.33)	(0.27)								(0.15)	

DIMENSIONS in: (mm)



Reel Cavity Dimensions

TYPE	A	B
GR43	.098 (2.5)	.20 (5.1)
GR43-2	.14 (3.6)	.19 (4.9)
GR44-1	.21 (5.2)	.24 (6.1)

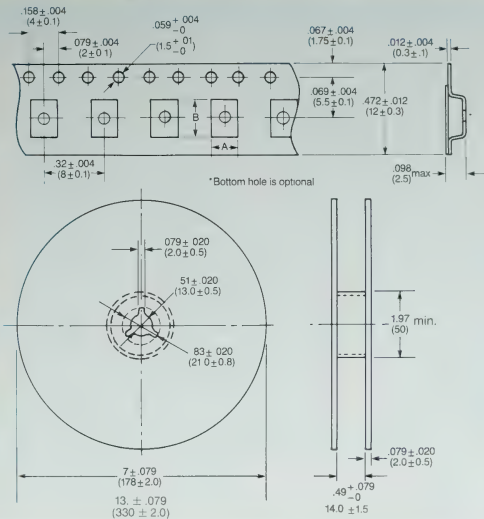
	GR43	GR43-2	GR44-1
L	.180±.020 (4.6±0.5)	.180±.020 (4.6±0.5)	.220±.020 (5.6±0.5)
W	.080±.012 (2.00±0.3)	.125±.016 (3.2±0.4)	.200±.020 (5.1±0.5)
T (max)	.060 (1.5)	.070 (1.8)	.080 (2.0)
g (min)	.080 (2.0)	.080 (2.0)	.080 (2.0)
e (min)	.012 (0.3)	.012 (0.3)	.012 (0.3)

Standard quantities per reel are:

TYPE & SIZE	Reel Size 7±.079 (178±2.0) Quantity per Reel	Reel Size 13±.079 (330±2.0) Quantity per Reel
GR43	1,000 pcs. max.	5,000 pcs. max. 4,000 pcs. max.
GR43-2	1,000 pcs. max.	5,000 pcs. max. 4,000 pcs. max.
GR44-1	500 pcs. max.	3,000 pcs. max.

*: Quantity per reel will vary with thickness of dielectric

T: Thickness of chip



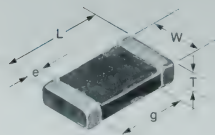
CAPACITANCE RANGE—12mm TAPE & REEL

TEMP. CHAR.	COG						X7R						Y5V						Z5U					
TYPE AND SIZE	GR43		GR43-2		GR44-1		GR43		GR43-2		GR44-1		GR43		GR43-2		GR44-1		GR43		GR43-2		GR44-1	
VOLTAGE	50V	100V	50V	100V	50V	100V	50V	100V	50V	100V	50V	100V	25V	50V	25V	50V	25V	50V	50V	100V	50V	100V	50V	100V
CAPACITANCE																								
(pF) 1																								
10																								
100																								
1,000																								
(μF) .01	(1,600)	(1,100)	(2,700)	(3,900)	(5,100)	(4,700)																		
	(3,600)	(2,400)	(3,900)	(3,900)	(5,100)	(4,700)																		
					(.01)	(.01)																		
							(.033)						(.015)	(.015)					(.047)					
							(.068)																	
							(.082)	(.15)	(.10)															
.1							(.12)												(.33)	(.1)	(.15)	(.15)		(.22)
1													(.68)	(.47)	(.82)	(.68)	(.82)	(.82)	(.47)		(.68)	(.68)		(.39)
1.0																			(.15)	(.15)			(.15)	

HIGH FREQUENCY CHIPS-COG

GR706-708-710 SERIES

For MOBILE COMMUNICATIONS APPLICATIONS



DIMENSIONS in:(mm)

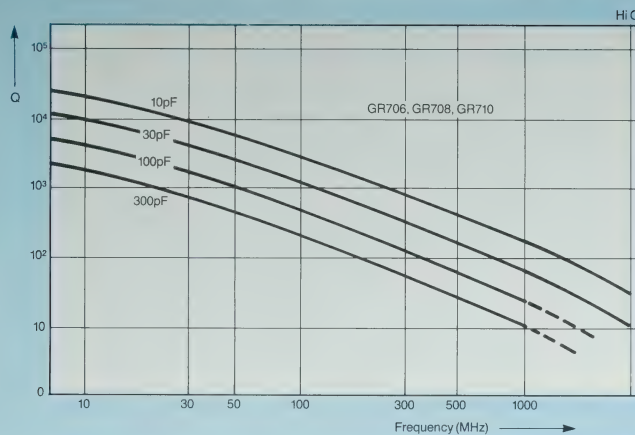
	GR706	GR708	GR710
L	.050±.012 (1.25±0.3)	.080±.012 (2.0±0.3)	.125±.016 (3.2±0.4)
W	.040±.012 (1.0±0.2)	.050±.012 (1.25±0.3)	.100±.012 (2.5±0.3)
T (max)	.040 (1.0)	.050 (1.25)	.067 (1.7)
g (min)	.02 (0.5)	.03 (0.7)	.04 (1.0)
e (min)	.008 (0.2)	.01 (0.25)	.012 (0.3)

TYPE AND SIZE	GR706			GR708			GR710		
VOLTAGE	50V	100V	200V	50V	100V	200V	50V	100V	200V
CAPACITANCE									
(pF)			(.5)			(.5)			(.5)
10									
12									
13									
15		(15)	(13)						
18									
22		(22)							
24	(24)								
27									
33									
39									
47									
51									
56	(51)				(56)	(51)			
68									
82									
91									
100				(100)	(91)				
110									
120									
150									
160				(160)					
180								(180)	(160)
220									
270									
330									
390									
470									
510									
560							(560)	(510)	
680									
820									
1,000							(1,000)		

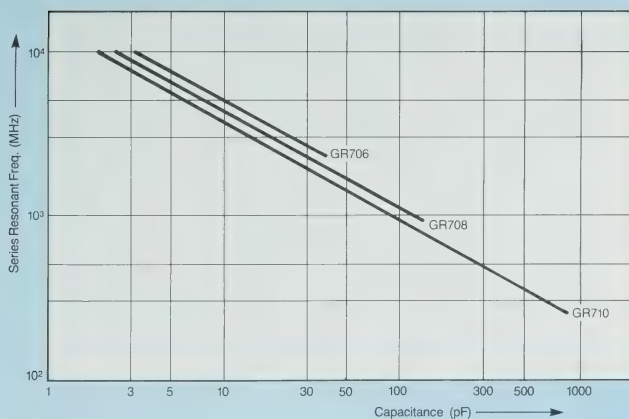
NOTES: 1) GR708 and 710 Hi-Q Chip Capacitors are available on 8mm Tape and Reel for Auto Placement. Contact factory.
2) GRM Barrier layer terminations are available on request.

HIGH FREQUENCY CHIPS-COG TYPICAL PERFORMANCE CHARACTERISTICS

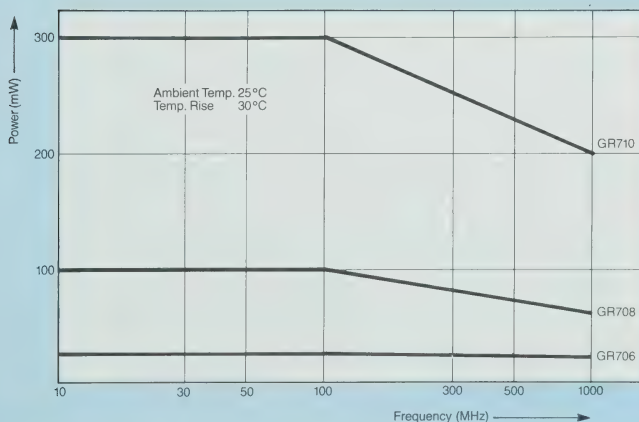
Q vs. Frequency



Series Resonant Frequency Vs. Capacitance Value

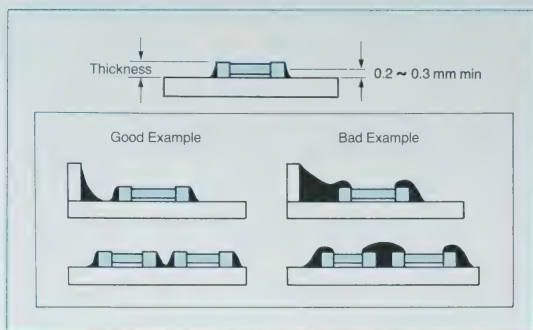


Power Capability



NOTES ON SOLDERING

- 1) Use rosin type flux and not a highly acidic flux.
- 2) Use 60/40 eutectic solder with 2% silver to alleviate leaching.
- 3) Preheat board and components prior to soldering so that a maximum temperature differential of 150°C exists between component and solder. This eliminates the risk of cracking the ceramic chip which will cause electrical degradation.
- 4) Inspect end terminations after prolonged soldering time to ensure leaching of silver has not occurred. End surfaces of chip should be covered with termination material.
- 5) When soldering, ensure the solder reaches a minimum of 1/3 (0.2—0.3mm) of the terminal thickness. Optimum solder fillet is approximately 2/3 of thickness of end termination. (see below)



- 6) All cooling of soldered assembly at room temperature. If immersion quenching is used, ensure a maximum temperature differential of 150°C.
- 7) Recommended time/temperature profile for soldering

Soldering with Iron

Under the following condition, preheating is not required.

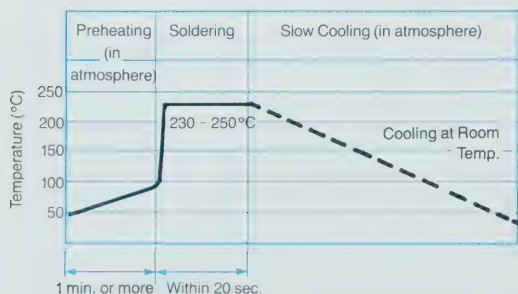
Soldering Iron : Within 30W

Head of Iron diameter : Within 3mm

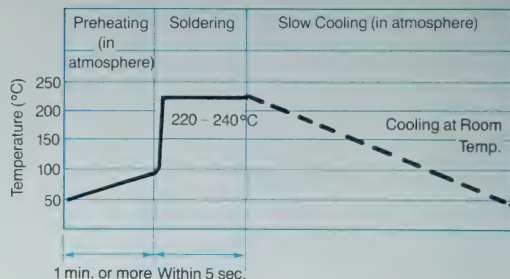
Iron temperature : Within 280°C

Do not allow the Iron tip to directly touch the ceramic (the terminal electrode can be touched).

Soldering with Reflow

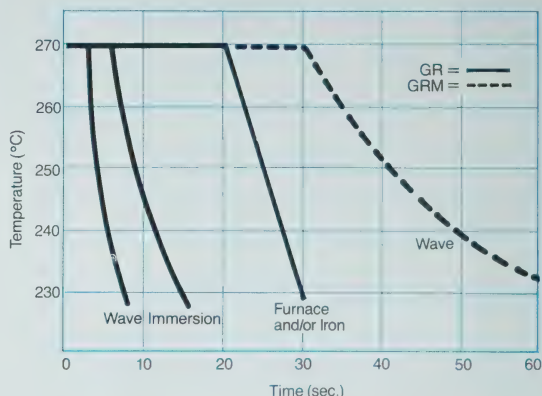


Immersion Method (flow, dip soldering)



When using the immersion method, immerse the entire element into the solder solution. Quickly remove in order to eliminate thermal shocking of the chip. If the capacitor is not totally immersed, damage may occur.

- 8) Recommended temperature/time for soldering



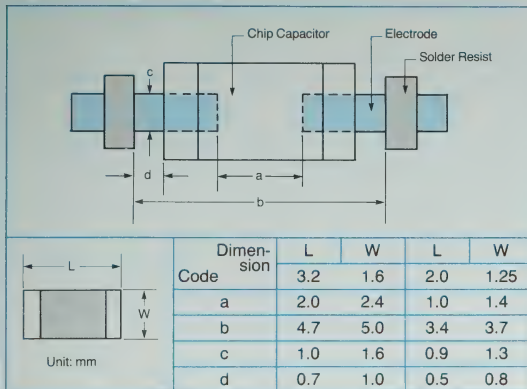
When soldering is to be repeated, the allowable time is the cumulative time. The allowable time under different soldering methods shall be the accumulation of time under each condition.

Notice: Cleaning

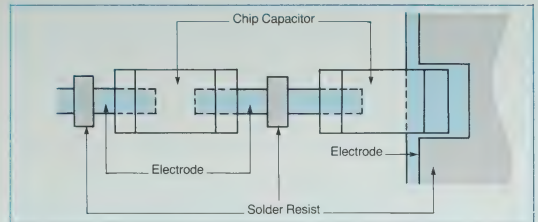
Clean the soldered parts with Freon, Chlorothene or Trichlene. Avoid ultrasonic cleaning as it may weaken the adhesion of the terminal electrode.

NOTES ON CONSTRUCTION OF BOARD PATTERN

1) Recommended construction and dimensions of pattern (example)



2) If two or more chip capacitors are to be arranged closely together in the circuit, separate the board electrodes with solder resist as shown in the figure below. Also in case the dimensions b and c shown in the left figure become large when making patterns, cover them with the solder resist so that they will achieve the recommended dimensions.



3) Mounting procedure

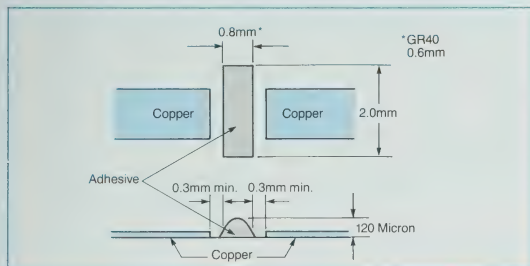
The following table shows the mounting dimensions, including the soldering section when actually arranging the chip capacitors on the board.

GR40	3.7 X 1.8	GR42-6	5.0 X 2.5
------	-----------	--------	-----------

(Unit: mm)

NOTES ON MOUNTING CHIPS

1) Selection of Adhesive. Use epoxy resin with maximum viscosity (10,000cps or more).



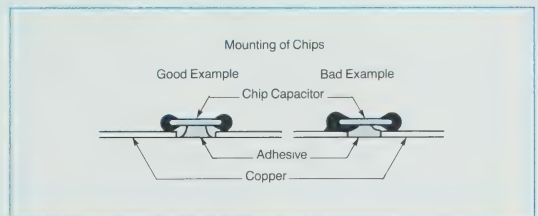
2) Printing on Board

(1) Pattern

Recommended material: Polyester Mesh 90# diameter 79μ

(2) Printing dimensions (example) GR42-6

3) Mounting of Chips. Mount the chip within 15 minutes of printing the adhesive.



MOUNTING PROCEDURE FOR CHIP-TYPE MONOLITHIC CERAMIC CAPACITOR TO PRINTED CIRCUIT BOARD

The following method is recommended as a direct mounting method of the chip type monolithic ceramic capacitor to alumina substrate and print boards.

Flow Chart for Processes	Materials Used and Facilities	Notes
Board (Substrate)	Four materials are suitable: (1) glass epoxy, (2) paper phenol, (3) alumina, and (4) phenol/polyimide laminate	Give consideration to thermal shrinkage and deflection in manufacturing environment
Coating of Adhesive	Coating of epoxy resin for adhesion	Applied to chip or P.C.B.
Fixture of Chips	Placement of chips by automatic or semi-automatic mounting equipment	Automatic or semi-automatic supply of chips possible by packaging in Tape & Reel
Baking of Adhesive	Oven or tunnel or (U.V. cure) furnace	For 5-7 min. at 150°C for oven
Supply of Other Parts	Leaded/large chip components	Auto insertion from top side of P.C.B.
Supply of Flux	Flux (Rosin)	Supply of flux by the foam jet system
Preheating	Preheat atmosphere (150°C maximum temperature difference)	
Soldering	Reflow solder, wave solder or vapor phase	Follow recommended soldering conditions
Slow-Cooling	Cool in room temperature	
Washing	Wash with Trichlene or Freon	

CHIP- MARKING SPECIFICATIONS

- 1) Chip capacitor marking is available at the customer's request.
The marking specification incorporates a two character alpha numeric designator to indicate capacitance value (per Table 1 below).

- 2) Marking Color: Standard Chips: Black
 HiFrequency/HiQ Series: Blue

EXAMPLES:

GR40 type		GR42-6 and larger types	
GR40COG101K50	GR40X7R103M50	GR42-6COG101K50	GR42-6X7R103M50

Bar Code

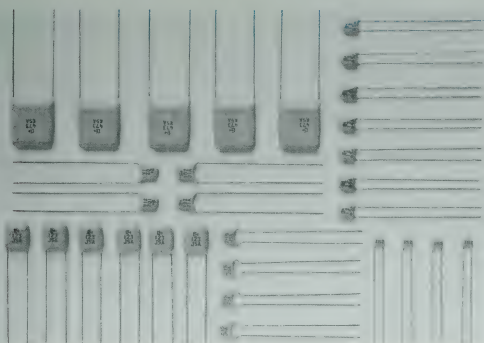
A bar code designation for temperature coefficient (T.C) may be provided on GR42-6 sizes and larger. No bar code (T.C.) marking is available on GR40 size.

NPO=□□, N150=□□, N220=□□, N330=□□, N470=□□,
N750=□□, Y5V=□□, Z5U=□□, X7R=□□

Other T.C. Designators are available. Contact factory.

NUMBER		0	1	2	3	4	5	6	7	8	9
LETTER	NUMBER	MULTIPLIER									
		10 ⁰	10 ¹	10 ²	10 ³	10 ⁴	10 ⁵	10 ⁶	10 ⁷	10 ⁸	10 ⁻¹
A	1	1pF	10pF	100pF	1,000pF	10,000pF	100,000pF	1μF	10μF	100μF	0.1pF
B	1.1	1.1	11	110	1,100	11,000	110,000	1.1	11	110	0.11
C	1.2	1.2	12	120	1,200	12,000	120,000	1.2	12	120	0.12
D	1.3	1.3	13	130	1,300	13,000	130,000	1.3	13	130	0.13
E	1.5	1.5	15	150	1,500	15,000	150,000	1.5	15	150	0.15
F	1.6	1.6	16	160	1,600	16,000	160,000	1.6	16	160	0.16
G	1.8	1.8	18	180	1,800	18,000	180,000	1.8	18	180	0.18
H	2	2	20	200	2,000	20,000	200,000	2	20	200	0.2
J	2.2	2.2	22	220	2,200	22,000	220,000	2.2	22	220	0.22
K	2.4	2.4	24	240	2,400	24,000	240,000	2.4	24	240	0.24
L	2.7	2.7	27	270	2,700	27,000	270,000	2.7	27	270	0.27
M	3	3	30	300	3,000	30,000	300,000	3	30	300	0.3
N	3.3	3.3	33	330	3,300	33,000	330,000	3.3	33	330	0.33
P	3.6	3.6	36	360	3,600	36,000	360,000	3.6	36	360	0.36
Q	3.9	3.9	39	390	3,900	39,000	390,000	3.9	39	390	0.39
R	4.3	4.3	43	430	4,300	43,000	430,000	4.3	43	430	0.43
S	4.7	4.7	47	470	4,700	47,000	470,000	4.7	47	470	0.47
T	5.1	5.1	51	510	5,100	51,000	510,000	5.1	51	510	0.51
U	5.6	5.6	56	560	5,600	56,000	560,000	5.6	56	560	0.56
V	6.2	6.2	62	620	6,200	62,000	620,000	6.2	62	620	0.62
W	6.8	6.8	68	680	6,800	68,000	680,000	6.8	68	680	0.68
X	7.5	7.5	75	750	7,500	75,000	750,000	7.5	75	750	0.75
Y	8.2	8.2	82	820	8,200	82,000	820,000	8.2	82	820	0.82
Z	9.1	9.1	91	910	9,100	91,000	910,000	9.1	91	910	0.91
a	2.5	2.5	25	250	2,500	25,000	250,000	2.5	25	250	0.25
b	3.5	3.5	35	350	3,500	35,000	350,000	3.5	35	350	0.35
d	4	4	40	400	4,000	40,000	400,000	4	40	400	0.4
e	4.5	4.5	45	450	4,500	45,000	450,000	4.5	45	450	0.45
f	5	5	50	500	5,000	50,000	500,000	5	50	500	0.5
m	6	6	60	600	6,000	60,000	600,000	6	60	600	0.6
n	7	7	70	700	7,000	70,000	700,000	7	70	700	0.7
t	8	8	80	800	8,000	80,000	800,000	8	80	800	0.8
y	9	9	90	900	9,000	90,000	900,000	9	90	900	0.9

CONFORMAL COATED RADIAL LEADS



OUTSTANDING CHARACTERISTICS:

- Wide capacitance, T.C., voltage and tolerance range
- Industry standard sizes
- Tape and Reel available for auto insertion
- Various lead spacing available
- Marking standard or to customer specification

PART NUMBERING

TYPE RPE 110-XXX	TEMP. CHAR. (Note 2) X7R	CAPACITANCE 103	TOLERANCE K	VOLTAGE 50V
CAPACITOR TYPE AND SIZE Used only for tape and reel or non-standard requirements. See pages 28 and 29.	TEMPERATURE CHARACTERISTICS COG = 0 ± 30 ppm (Note 1), -55°C to $+125^{\circ}\text{C}$ X7R = $\pm 15\%$, -55°C to $+125^{\circ}\text{C}$ Z5U = ± 22 , -56% , $+10^{\circ}\text{C}$ to $+85^{\circ}\text{C}$ N150 = ± 60 ppm, -55°C to $+125^{\circ}\text{C}$ N220 = ± 60 ppm, -55°C to $+125^{\circ}\text{C}$ N330 = ± 60 ppm, -55°C to $+125^{\circ}\text{C}$ N470 = ± 60 ppm, -55°C to $+125^{\circ}\text{C}$ N750 = ± 120 ppm, -55°C to $+125^{\circ}\text{C}$	CAPACITANCE VALUE Expressed in picofarads and identified by a three-digit number. First two digits represent significant figures. Last digit specifies the number of zeros to follow. For values below 10pF, the letter "R" is used as the decimal point and the last digit becomes significant.	CAPACITANCE TOLERANCE (Note 2) COG: (10pF or less) C = $\pm 25\%$ D = $\pm 5\%$ (over 10pF) G = $\pm 2\%$ J = $\pm 5\%$ K = $\pm 10\%$ (F = $\pm 1\%$ on special request for RPE 121/122 and larger for cap. values greater than 10pF.) X7R: K = $\pm 10\%$ M = $\pm 20\%$ (J = $\pm 5\%$ on special request) Z5U: M = $\pm 20\%$ Z = ± 80 , -20%	VOLTAGE Identified by a two or three digit number. 50 and 100V standard (200V and 500V on special request)

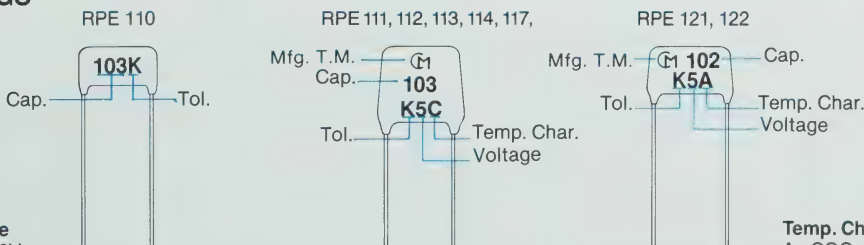
NOTES: T.C. Tolerance

1. Capacitance (pF)	T.C. Tolerance (ppm)
4-2.0	± 250 (K)
2.1-3.9	± 120 (J)
4.0-9.9	± 60 (H)
10 and over	± 30 (G)

Refer to EIA RS 198 for limitations.

2. Other T.C.'s available on special request.

MARKINGS



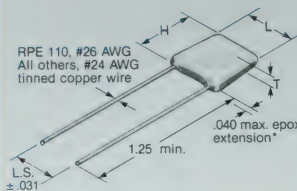
Voltage Code

2 = 25V, 5 = 50V,
1 = 100V, 6 = 200V, 9 = 500V

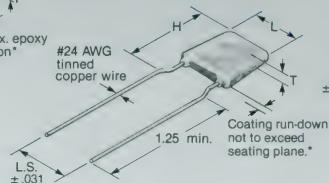
Temp. Char. Code

A = COG, C = X7R,
E = Z5U

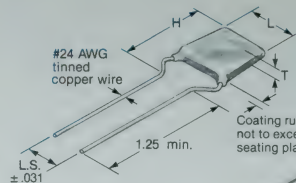
CONFORMAL COATED RADIAL LEADS-COG (NPO) RPE Series



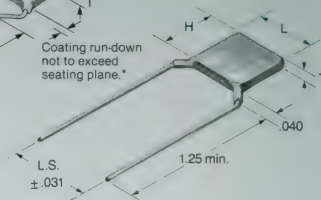
A



B



C



D

*.031 max. epoxy extension upon request

BODY TYPE	RPE110				RPE121/122				RPE111/112			
STYLE	A				C/B				A/D			
VOLTAGE	50	100	200	500	50	100	200	500	50	100	200	500
CAPACITANCE												
(pF)	(1)	(1)	(1)	NOT A V A I L A B L E	(1)	(1)	(1)					
10												
15												
22												
33												
47												
68												
± 10												
12												
15												
18												
22												
27												
33												
39												
47												
56								(68)				
68												
82												
100			(82)									(130)
120												
150								(130)				
180												
220												
270												
330											(360)	(240)
390							(360)					
470												
560		(470)										
680												
820												
1,000	(820)										(1,100)	
1,200												
1,500												
1,800												
2,200						(2,000)				(2,000)		
2,700									(3,300)			
3,300										(2,700)		
3,900												
4,700						(3,900)			(3,900)			
5,600												
6,800												
8,200												
(μF)												
.01												
.012												
.015												
.018												
.022												
.027												
.033												
.039												
.047												
.056												

DIMENSIONS in:(mm)

	RPE110	RPE121/122	RPE111/112	RPE113	RPE114	RPE117
L	.138 (3.5)	.200 (5.1)	.200 (5.1)	.300 (7.6)	.400 (10.2)	.500 (12.7)
H	.120 (3.1)	.250 (6.4)	.200 (5.1)	.300 (7.6)	.400 (10.2)	.500 (12.7)
T	.100 (2.5)	.125 (3.2)	.125 (3.2)	.150 (3.8)	.150 (3.8)	.200 (5.1)
L.S.	.100 (2.5)	.100/.200 (2.5)/(5.1)	.100/.200 (2.5)/(5.1)	.200 (5.1)	.200 (5.1)	.400 (10.2)

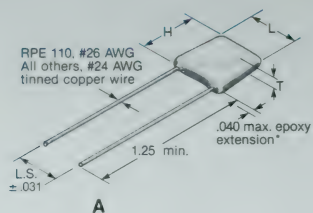
BODY TYPE	RPE113				RPE114				RPE117			
STYLE	A				A				A			
VOLTAGE	50	100	200	500	50	100	200	500	50	100	200	500
CAPACITANCE												
(pF) 1.0												
1.5												
2.2												
3.3												
4.7												
6.8												
± 10												
12												
15												
18												
22												
27												
33												
39												
47												
56												
68												
82												
100												
120												
150				(240)								
180												
220												
270												
330												
390												
470												
560												
680												
820								(820)				
1,000			(1,100)	(820)								
1,200												
1,500												
1,800												
2,200												(2,400)
2,700												
3,300	(3,900)	(3,300)					(3,600)	(2,400)				
3,900			(3,900)									
4,700												
5,600												
6,800												
(μF) 8,200												
.01											(.01)	(6,800)
.012						(.012)					(.013)	
.015		(.012)					(.01)					
.018					(.018)							
.022	(.018)								(.033)	(.027)		
.027							(.027)					
.033					(.033)							
.039												
.047												
.056										(.047)		

± Other cap values available between 1pF and 10 pF.

(.056)

CONFORMAL COATED TEMPERATURE COMPENSATING RPE Series

RPE 110

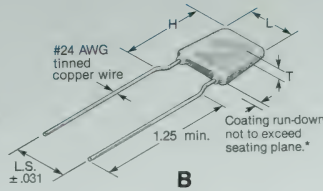
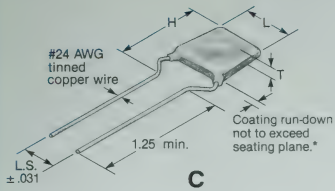


DIMENSIONS in:(mm)

L	.138 (3.5)
H	.120 (3.1)
T	.100 (2.5)
L.S.	.100 (2.5)

TEMPERATURE COEFFICIENT	N150 (P2H)		N220 (R2H)		N330 (S2H)		N470 (T2H)		N750 (U2J)	
VOLTAGE	50	100	50	100	50	100	50	100	50	100
CAPACITANCE										
(pF)										
1	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
..										
10										
12										
15										
18										
22										
27										
33										
39										
47										
56										
68										
82										
100										
120										
150								(120)		
180										
220								(220)		
270										
330		(270)								
390	(330)			(330)		(330)				
470										
560			(470)		(470)					
680										
820										(680)
1,000									(1,000)	
1,200										
1,500										
1,800										
2,200										
2,700										
3,300										
3,900										
4,700										

DIMENSIONS in: (mm)

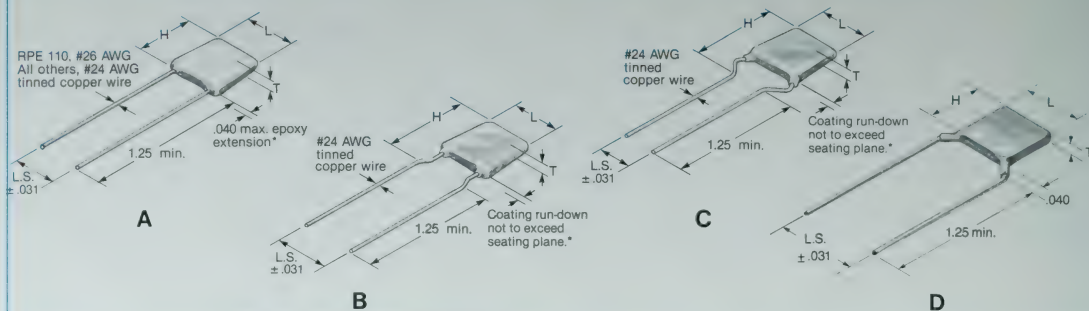


L	.200 (5.1)
H	.250 (6.4)
T	.125 (3.2)
L.S.	.100/.200 (2.5)/(5.0)

TEMPERATURE COEFFICIENT	N150 (P2H)		N220 (R2H)		N330 (S2H)		N470 (T2H)		N750 (U2J)	
VOLTAGE	50	100	50	100	50	100	50	100	50	100
CAPACITANCE										
(pF)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
1										
10										
12										
15										
18										
22										
27										
33										
39										
47										
56										
68										
82										
100										
120										
150										
180										
220										
270								(220)		
330										
390										
470										
560										
680										
820										
1,000										
1,200										
1,500								(1,200)		
1,800										
2,200		(1,800)								
2,700	(2,200)			(2,200)						
3,300			(2,700)							
3,900					(3,300)	(2,700)				
4,700									(4,700)	(3,900)

**Other cap values available upon request.

CONFORMAL COATED RADIAL LEADS-X7R RPE Series



* .031 max. epoxy extension upon request

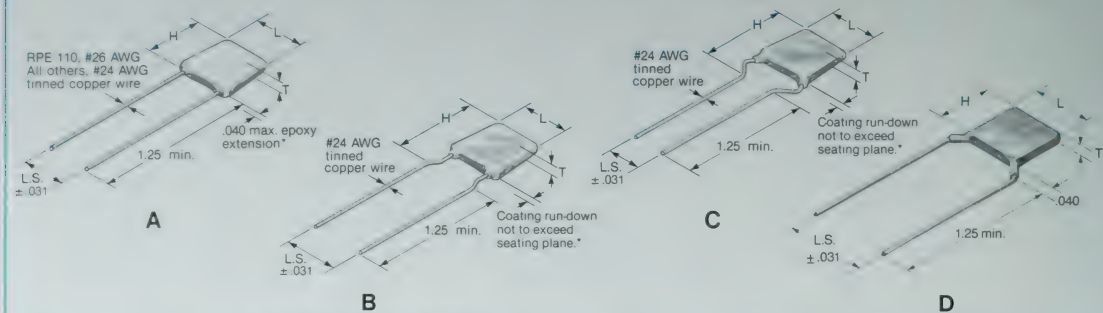
BODY TYPE	RPE110				RPE121/122				RPE111/112			
STYLE	A				C/B				A/D			
VOLTAGE	50	100	200	500	50	100	200	500	50	100	200	500
CAPACITANCE												
(pF) 220	(220)	(220)	(220)	NOT A V A I L A B L E	(220)	(220)	(220)	(220)				
270												
330												
390												
470												
560												
680												
820												
1,000												
1,200												
1,500				NOT A V A I L A B L E								
1,800												
2,200												
2,700												
3,300												
3,900			(3,300)									
4,700								(3,900)				(4,700)
5,600												
6,800												
8,200							(6,800)				(8,200)	(6,200)
(μF) 01				NOT A V A I L A B L E								
012												
015		(.012)										
018												
022												
027	(.022)											
033												
039												
047												
056						(.047)				(.056)		
068				NOT A V A I L A B L E								
082											(.056)	
1												
12						(.12)			(.15)	(.1)		
15												
18									(.18)			
22												
27												
33												
39												
47				NOT A V A I L A B L E								
56												
68												
82												
1												
12												
15												
18												
22												
27												

DIMENSIONS in:(mm)

	RPE110	RPE121/122	RPE111/112	RPE113	RPE114	RPE117
L	.138 (3.5)	.200 (5.1)	.200 (5.1)	.300 (7.6)	.400 (10.2)	.500 (12.7)
H	.120 (3.1)	.250 (6.4)	.200 (5.1)	.300 (7.6)	.400 (10.2)	.500 (12.7)
T	.100 (2.5)	.125 (3.2)	.125 (3.2)	.150 (3.8)	.150 (3.8)	.200 (5.1)
L.S.	.100 (2.5)	.100/.200 (2.5/5.1)	.100/.200 (2.5/5.1)	.200 (5.1)	.200 (5.1)	.400 (10.2)

BODY TYPE	RPE113				RPE114				RPE117			
STYLE	A				A				A			
VOLTAGE	50	100	200	500	50	100	200	500	50	100	200	500
CAPACITANCE												
(pF) 220												
270												
330												
390												
470												
560												
680												
820												
1,000												
1,200												
1,500												
1,800												
2,200												
2,700												
3,300												
3,900												
4,700												
5,600				(6.800)								
6,800												
8,200												
(μF) .01												
.012												
.015												
.018												
.022												
.027				(.02)				(.027)				
.033												
.039												
.047												
.056												
.068			(.068)									
.082								(.068)				(.082)
.1												
.12		(.12)										
.15												(.12)
.18							(.22)					
.22	(.22)		(.18)									
.27												
.33												
.39		(.33)				(.39)						
.47												
.56											(.68)	
.68								(.56)				(.68)
.82	(.68)				(.82)							
1												
1.2						(1.0)				(1.2)		
1.5										(1.2)		
1.8												
2.2					(1.8)				(2.2)			

CONFORMAL COATED RADIAL LEADS-Z5U RPE Series



*.031 max. epoxy extension upon request

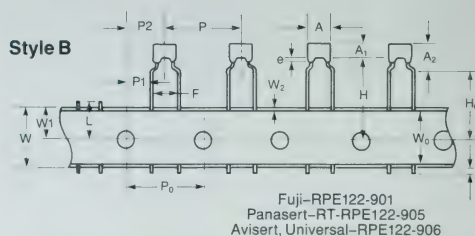
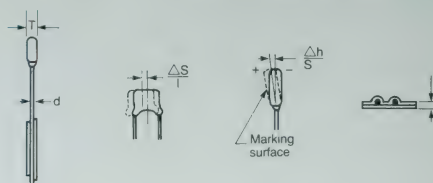
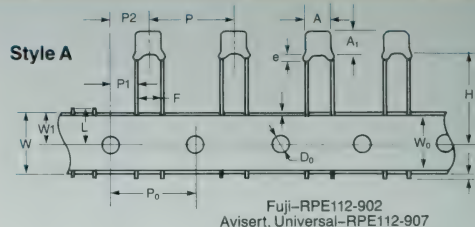
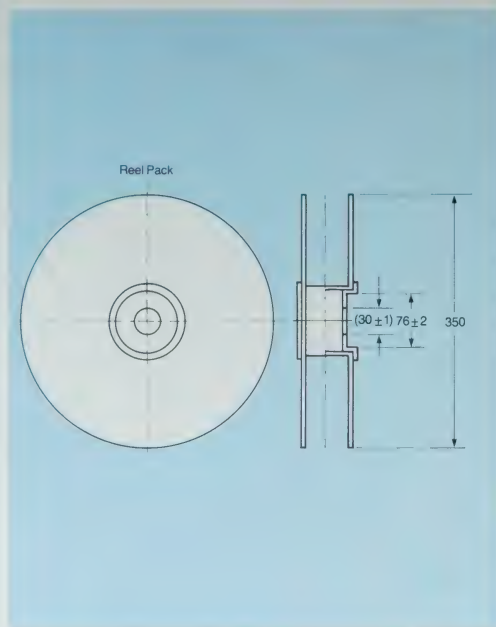
BODY TYPE	RPE110				RPE121/122				RPE111/112			
STYLE	A				C/B				A/D			
VOLTAGE	50	100	200	500	50	100	200	500	50	100	200	500
CAPACITANCE												
(pF) 1.000	(1,000)	(1,000)	(1,000)	NOT A V A I L A B L E	(1,000)	(1,000)	(1,000)	(1,000)				
1.500												
2.200												
3.300			(3,300)									
4.700												
6.800				NOT A V A I L A B L E								
(μF) .01								(6,800)				(.01)
.015												(.01)
.022		(.015)					(.015)				(.022)	
.033												
.047				NOT A V A I L A B L E							(.039)	
.068												
.1	(.068)											
.15												
.22						(.15)				(.22)		
.33				NOT A V A I L A B L E	(.33)					(.47)		
.47										(.47)		
.68												
1.0												
1.5												
2.2				NOT A V A I L A B L E								
3.3												
4.7												

DIMENSIONS in:(mm)

	RPE110	RPE121/122	RPE111/112	RPE113	RPE114	RPE117
L	.138 (3.5)	.200 (5.1)	.200 (5.1)	.300 (7.6)	.400 (10.2)	.500 (12.7)
H	.120 (3.1)	.250 (6.4)	.200 (5.1)	.300 (7.6)	.400 (10.2)	.500 (12.7)
T	.100 (2.5)	.125 (3.2)	.125 (3.2)	.150 (3.8)	.150 (3.8)	.200 (5.1)
L.S.	.100 (2.5)	.100/ .200 (2.5)/(5.1)	.100/ .200 (2.5)/(5.1)	.200 (5.1)	.200 (5.1)	.400 (10.2)

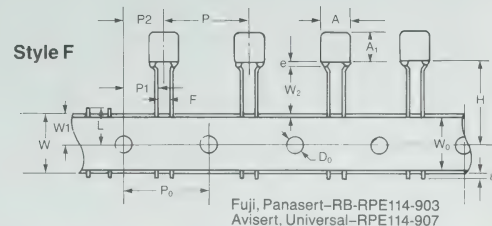
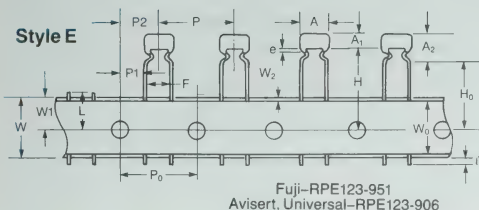
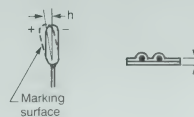
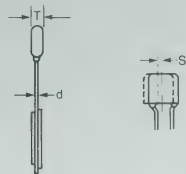
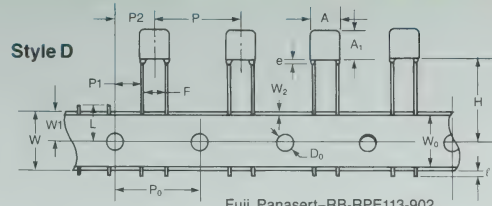
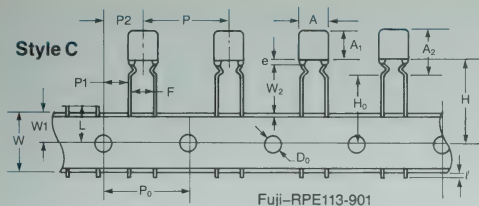
BODY TYPE	RPE113				RPE114				RPE117			
STYLE	A				A				A			
VOLTAGE	50	100	200	500	50	100	200	500	50	100	200	500
CAPACITANCE												
(pF) 1,000												
1,500												
2,200												
3,300												
4,700												
6,800												
(μF) .01				(.015)								
.015												
.022												
.033												
.047			(.047)	(.033)				(.047)				
.068												
.1							(.1)	(.1)				
.15												(.15)
.22												
.33		(.33)	(.22)									(.22)
.47											(.33)	
.68	(.68)	(.47)			(.68)	(.47)					(.33)	
1.0											(.33)	
1.5					(1.0)					(1.5)	(1.0)	
2.2	(1.5)											
3.3					(2.2)					(2.2)		
4.7					(3.3)				(4.7)			

CONFORMAL COATED RADIAL LEADS TAPE & REEL for AUTO INSERTION



DIMENSIONS in: (mm)

POSITION		RPE112-902	RPE112-907	RPE122-901	RPE122-905	RPE122-906
STYLE	DIM.	A	A	B	B	B
Taping Pitch	P	12.7	12.7	12.7	12.7	12.7
Feed Hole Pitch	P ₀	12.7±0.2	12.7±0.2	12.7±0.2	12.7±0.2	12.7±0.2
Feed Hole Position	P ₂	6.35±1.3	6.35±1.3	6.35±1.3	6.35±1.3	6.35±1.3
Feed Hole Position	P ₁	3.85±0.7	3.85±0.7	3.85±0.7	3.85±0.7	3.85±0.7
Lead Space	F	5.20±0.4	5.20±0.4	5.20±0.4	5.20±0.4	5.20±0.4
Body Width	A	5.0 max	5.0 max	5.0 max	5.0 max	5.0 max
Body Height	A ₁	5.0 max	5.0 max	5.0 max	5.0 max	5.0 max
Body Height	A ₂	—	—	6.3 max	8.5 max	6.3 max
Body Thickness	T	3.15 max	3.15 max	3.15 max	3.15 max	3.15 max
Deviation Along Tape	ΔS	±2.0	±2.0	±2.0	±2.0	±2.0
Width of Tape Carrier	W	18.0±0.5	18.0±0.5	18.0±0.5	18.0±0.5	18.0±0.5
Half Width of Tape Carrier	W ₁	9.0 ^{+0.5} _{-0.5}	9.0 ^{+0.5} _{-0.5}	9.0 ^{+0.5} _{-0.5}	9.0 ^{+0.5} _{-0.5}	9.0 ^{+0.5} _{-0.5}
Lead Length	H ₀	—	—	16.0±0.5	16.0±0.5	20.0±0.5
Lead Length	H	16.5±0.5	20.0±0.5	18.0±1.0	20.0±1.0	22.0±1.0
Lead Protrusion	ℓ	+0.5 to -1.0	+0.5 to -1.0	+0.5 to -1.0	+0.5 to -1.0	+0.5 to -1.0
Diameter of Feed Hole	D ₀	4.0±0.1	4.0±0.1	4.0±0.1	4.0±0.1	4.0±0.1
Lead Wire	d	0.5±0.05	0.5±0.05	0.5±0.05	0.5±0.05	0.5±0.05
Total Tape Thickness	t	0.7±0.2	0.7±0.2	0.7±0.2	0.7±0.2	0.7±0.2
Deviation Across Tape	Δh	±1.0	±1.0	±1.0	±1.0	±1.0
Cutting Position Failure	L	11.0 ^{+1.0} _{-1.0}	11.0 ^{+1.0} _{-1.0}	11.0 ^{+1.0} _{-1.0}	11.0 ^{+1.0} _{-1.0}	11.0 ^{+1.0} _{-1.0}
Width of Masking Tape	W ₀	12.5 min	12.5 min	12.5 min	12.5 min	12.5 min
Margin Between Tapes	W ₂	1.5±1.5	1.5±1.5	1.5±1.5	1.5±1.5	1.5±1.5
Pants Length	e	1.5 max	1.5 max	1.5 max	1.5 max	1.5 max



DIMENSIONS in: (mm)

DESCRIPTION		RPE113-901	RPE113-902	RPE113-903	RPE113-907	RPE123-901*	RPE123-906*	RPE123-951*	RPE114-903	RPE114-907
STYLE	DIM.	C	D	D	D	E	E	E	F	F
Taping Pitch	P	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7
Feed Hole Pitch	P ₀	12.7±0.2	12.7±0.2	12.7±0.2	12.7±0.2	12.7±0.2	12.7±0.2	12.7±0.2	12.7±0.2	12.7±0.2
Feed Hole Position	P ₂	6.35±1.3	6.35±1.3	6.35±1.3	6.35±1.3	6.35±1.3	6.35±1.3	6.35±1.3	6.35±1.3	6.35±1.3
Feed Hole Position	P ₁	3.85±0.7	3.85±0.7	3.85±0.7	3.85±0.7	3.85±0.7	3.85±0.7	3.85±0.7	3.85±0.7	3.85±0.7
Lead Space	F	5.2±0.4	5.20±0.4	5.20±0.4	5.20±0.4	5.20±0.4	5.08±0.5	5.20±0.4	5.20±0.4	5.20±0.4
Body Width	A	7.5 max	7.5 max	7.5 max	7.5 max	7.5 max	7.5 max	7.5 max	10.0 max	10.0 max
Body Height	A ₁	7.5 max	7.5 max	7.5 max	7.5 max	5.0 max	5.0 max	5.0 max	10.0 max	10.0 max
Body Height	A ₂	10.0 max	—	—	—	6.3 max	6.3 max	6.3 max	—	—
Body Thickness	T	4.0 max	4.0 max	3.15 max	3.15 max	3.15 max	3.15 max	3.15 max	3.81 max	3.81 max
Deviation Along Tape	△S	±2.0	±2.0	±2.0	±2.0	±2.0	±2.0	±2.0	±2.0	±2.0
Width of Tape Carrier	W	18.0±0.5	18.0±0.5	18.0±0.5	18.0±0.5	18.0±0.5	18.0±0.5	18.0±0.5	18.0±0.5	18.0±0.5
Half Width of Tape Carrier	W ₁	9.0 ⁺⁰ _{-0.5}	9.0 ⁺⁰ _{-0.5}	9.0 ⁺⁰ _{-0.5}	9.0 ⁺⁰ _{-0.5}	9.0 ⁺⁰ _{-0.5}	9.0 ⁺⁰ _{-0.5}	9.0 ⁺⁰ _{-0.5}	9.0 ⁺⁰ _{-0.5}	9.0 ⁺⁰ _{-0.5}
Lead Length	H ₀	16.0±0.5	—	—	—	16.0±0.5	20.0±0.5	16.0±0.5	—	—
Lead Length	H	19.0±1.0	16.5±0.5	17.5±0.5	20.0±0.5	18.0±1.0	22.0±1.0	18.0±1.0	17.5±0.5	20.0±0.5
Lead Protrusion	f	+0.5 to -1.0	+0.5 to -1.0	+0.5 to -1.0	+0.5 to -1.0	+0.5 to -1.0	+0.5 to -1.0	+0.5 to -1.0	+0.5 to -1.0	+0.5 to -1.0
Diameter of Feed Hole	D ₀	4.0±0.1	4.0±0.1	4.0±0.1	4.0±0.1	4.0±0.1	4.0±0.1	4.0±0.1	4.0±0.1	4.0±0.1
Lead Wire	d	0.5±0.05	0.5±0.05	0.5±0.05	0.5±0.05	0.5±0.05	0.5±0.05	0.65±0.05	0.5±0.05	0.5±0.05
Total Tape Thickness	t	0.7±0.2	0.7±0.2	0.7±0.2	0.7±0.2	0.7±0.2	0.7±0.2	0.7±0.2	0.7±0.2	0.7±0.2
Deviation Across Tape	△h	±1.0	±1.0	±1.0	±1.0	±1.0	±1.0	±1.0	±1.0	±1.0
Cutting Position Failure	L	11.0 ⁺⁰ _{-1.0}	11.0 ⁺⁰ _{-1.0}	11.0 ⁺⁰ _{-1.0}	11.0 ⁺⁰ _{-1.0}	11.0 ⁺⁰ _{-1.0}	11.0 ⁺⁰ _{-1.0}	11.0 ⁺⁰ _{-1.0}	11.0 ⁺⁰ _{-1.0}	11.0 ⁺⁰ _{-1.0}
Width of Masking Tape	W ₀	12.5 min	12.5 min	12.5 min	12.5 min	12.5 min	12.5 min	12.5 min	12.5 min	12.5 min
Margin Between Tapes	W ₂	1.5±1.5	1.5±1.5	1.5±1.5	1.5±1.5	1.5±1.5	1.5±1.5	1.5±1.5	1.5±1.5	1.5±1.5
Pants Length	e	1.0 max	1.0 max	1.0 max	1.0 max	1.0 max	1.0 max	1.0 max	1.5 max	1.5 max

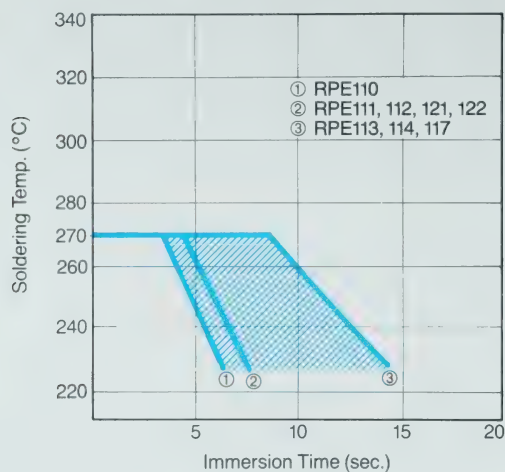
* RPE123 Series—Low Profile—contact factory for further information

CONFORMAL COATED RADIAL & AXIAL LEAD APPLICATION NOTES

RADIAL LEAD RPE SERIES



1. Allowable Conditions for Soldering Temperature vs. Time
Perform soldering within tolerance range (shaded area).



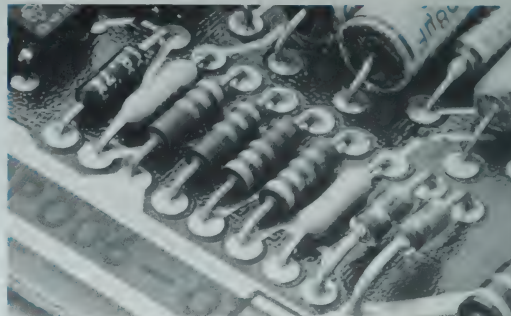
2. A) Do not impose a tensile load on the lead wire during solder heat exposure.
B) For RPE110, set base of lead 2mm above printed circuit board surface per diagram:

RPE110

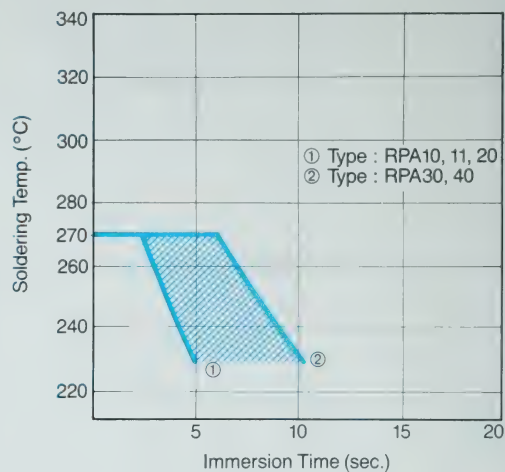
RPE111, 112, 121, 122
RPE113, 114, 117



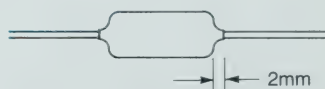
AXIAL LEAD RPA SERIES



1. Allowable Conditions for Soldering Temperature vs. Time
Perform soldering within tolerance range (shaded area).



2. When soldering, be sure to solder more than 2mm away from a capacitor main body.

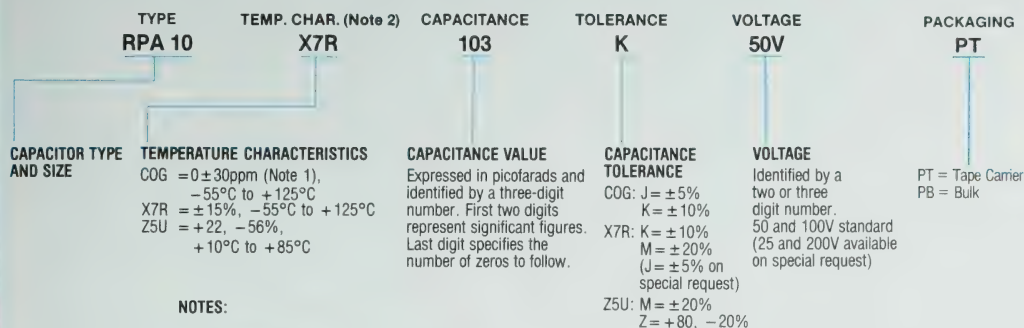




OUTSTANDING CHARACTERISTICS:

- Wide capacitance, T.C., voltage and tolerance range
- Industry standard sizes
- Tape and Reel available for auto insertion
- Marking standard or to customer specification

PART NUMBERING



NOTES:

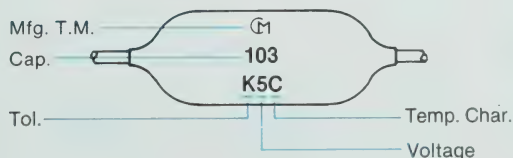
T.C. Tolerance

Capacitance (pF)	T.C. Tolerance (ppm)
4-2.0	± 250 (K)
2.1-3.9	± 120 (J)
4.0-9.9	± 60 (H)
10 and over	± 30 (G)

Refer to EIA RS198 for limitations.

- F(1%), G(2%) Available on special order for COG types with capacitance values greater than 10pF.

MARKINGS



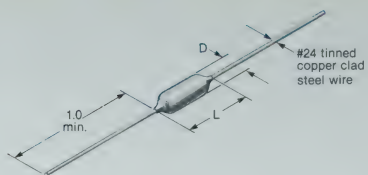
Voltage Code

2 = 25V, 5 = 50V,
1 = 100V, 6 = 200V

Temp. Char. Code

A = COG, C = X7R,
E = Z5U

CONFORMAL COATED AXIAL LEADS-COG (NPO) RPA Series

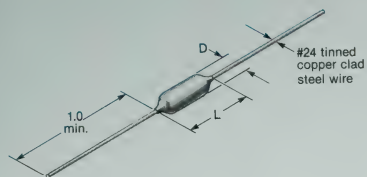


DIMENSIONS in: (mm)

	RPA10	RPA20	RPA30	RPA40
L (max)	.170 (4.3)	.260 (6.6)	.290 (7.4)	.400 (10.2)
D (max)	.100 (2.5)	.100 (2.5)	.150 (3.8)	.150 (3.8)

BODY TYPE		RPA 10		RPA 20		RPA 30		RPA 40	
VOLTAGE		50V	100V	50V	100V	50V	100V	50V	100V
CAPACITANCE									
(pF)	1	(1)	(1)						
	1.5								
	2								
	3								
	4								
	5								
	6								
	7								
	8								
	9								
	10								
	12								
	15								
	22								
	33								
	39								
	47								
	51								
	68								
	100								
	120								
	150								
	220								
	330								
	390								
	470								
	510								
	680								
	1,000				(910)				
	1,200	(1,100)	(820)	(1,200)	(1,000)	(1,200)	(1,200)		
	1,500			(1,900)					
	2,200								
	3,300								
	3,900					(3,300)	(3,300)	(3,900)	(3,900)
	4,700								
	5,100								
	6,800							(6,800)	(5,100)

CONFORMAL COATED AXIAL LEADS-X7R RPA Series



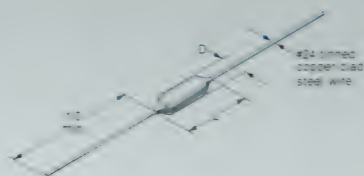
DIMENSIONS in: (mm)

	RPA10	RPA20	RPA30	RPA40
L (max)	.170 (4.3)	.260 (6.6)	.290 (7.4)	.400 (10.2)
D (max)	.100 (2.5)	.100 (2.5)	.150 (3.8)	.150 (3.8)

BODY TYPE		RPA 10		RPA 20		RPA 30		RPA 40	
VOLTAGE		50V	100V	50V	100V	50V	100V	50V	100V
CAPACITANCE									
(pF)	220	(220)	(220)						
	270								
	330								
	390								
	470								
	560								
	680								
	820								
	1,000								
	1,200								
(pF)	1,500								
	1,800								
	2,200								
	2,700								
	3,300								
	3,900								
	4,700								
	5,600								
	6,800								
	8,200								
(μF)	.01								
	.012								
	.015								
	.018								
	.022		(.018)		(.022)				
(μF)	.027				(.027)		(.033)		
	.033								
	.039								
	.047	(.039)		(.047)					
	.056			(.056)					
(μF)	.068					(.068)			
	.082								
	.1						(.1)		(.12)
	.12								
	.15								
(μF)	.18					(.15)		(.18)	
	.22								(.18)
	.27								

(.27)

CONFORMAL COATED AXIAL LEADS-Z5U RPA Series



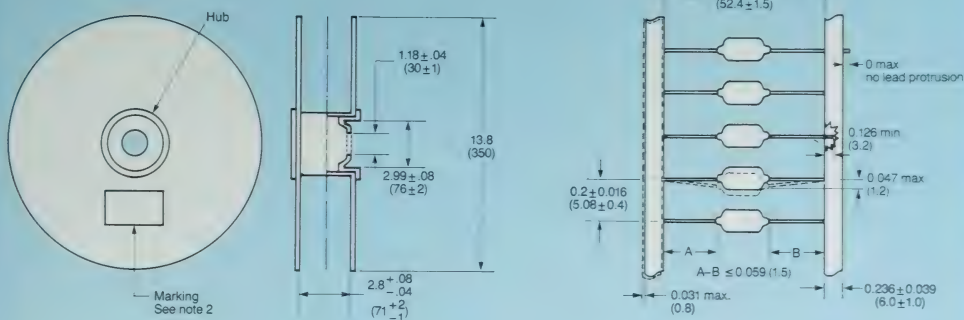
DIMENSIONS in: (mm)

	RPA10	RPA20	RPA30	RPA40
L (max)	170 (4.3)	260 (6.6)	290 (7.4)	400 (10.2)
D (max)	100 (2.5)	100 (2.5)	150 (3.8)	150 (3.8)

BODY TYPE	RPA 10		RPA 20		RPA 30		RPA 40	
VOLTAGE	50V	100V	50V	100V	50V	100V	50V	100V
CAPACITANCE								
(pF)								
1 000	(1.000)	(1.000)						
1 500								
2 200								
3 300								
4 700								
(μF)								
0.1								
0.15								
0.22		(1.022)						
0.33				(0.033)				
0.47				(0.033)				
0.68						(0.047)		
1								
1.5	(1.7)							
2.2			(1.15)	(1.15)				
3.3								
4.7								
6.8								
10								

CONFORMAL COATED AXIAL LEADS TAPE & REEL for AUTO INSERTION

DIMENSIONS in:(mm)



NOTES

- Standard quantities per reel are

Table 1

RPA 10	4000pcs
RPA 20	4000pcs
RPA 30	3000pcs
RPA 40	3000pcs

- Standard information marked on reel label is:

a: Customers part No.
b: Our part No.
c: Quantity
d: Inspection No.


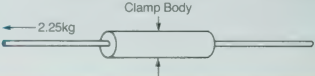
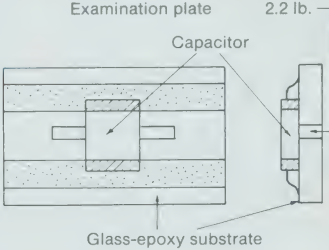

- Maximum 0.25% of capacitors per reel quantity may be missing with no consecutive misses.

SPECIFICATIONS

GENERAL

TEST	SPECIFICATION
Operating Temperature Range	COG: -55°C to $+125^{\circ}\text{C}$ X7R: -55°C to $+125^{\circ}\text{C}$ Z5U: $+10^{\circ}\text{C}$ to $+85^{\circ}\text{C}$ Y5V: -30°C to $+85^{\circ}\text{C}$
Temperature Coefficient	COG*: $0 \pm 30\text{ppm}/^{\circ}\text{C}$ over temp. range of -55°C to $+125^{\circ}\text{C}$ X7R: $\pm 15\%$ over temp. range of -55°C to $+125^{\circ}\text{C}$ Z5U: ± 22 , -56% over temp. range of $+10^{\circ}\text{C}$ to $+85^{\circ}\text{C}$ Y5V: ± 22 , -82% over temp. range of -30°C to $+85^{\circ}\text{C}$
	<div style="display: flex; justify-content: space-around;"> <div> T.C. Tolerance Capacitance (pF) $4-2.0$ $2.1-3.9$ $4.0-9.9$ 10 and over </div> <div> T.C. Tolerance (ppm) $\pm 250(\text{K})$ $\pm 120(\text{J})$ $\pm 60(\text{H})$ $\pm 30(\text{G})$ </div> </div> <p>*Refer to EIA RS198 for limitations.</p>

MECHANICAL

TEST	TEST METHOD	REQUIREMENT
Lead Pull Strength (RPE type only)	MIL-STD-202, 211A	Radial direction: RPE 110: 2 lb. min. others: 5 lb. min. 
Terminal Strength (RPA type only)		Tensile strength of lead wire terminal When the capacitor main body is fixed and a load is applied in the axial direction of each terminal slowly up to 2.25kg and kept for 5-10 seconds, the capacitor shall not be defective. 
Terminal Adhesion (GR type only)	Apply 2.2 lb. push for 5 seconds (except GR 39=1 lb.) Examination plate Capacitor Glass-epoxy substrate 	No evidence of peeling from substrate 
Solderability	MIL-STD-202, 208C Parts are immersed for 2 ± 0.5 sec. in a solder bath with a temperature of $230 \pm 5^{\circ}\text{C}$	Lead wire will exhibit $> 95\%$ coverage on conformal coated units. Chips will exhibit 95% coverage.
Resistance to Soldering Heat	MIL-STD-202, 210A Parts are immersed in solder bath: RPE 110, $270 \pm 5^{\circ}\text{C}$ for 3 ± 0.5 sec. All other RPE types: $350 \pm 10^{\circ}\text{C}$ for 3 ± 0.5 sec. GR type: $270^{\circ}\text{C} \pm 5^{\circ}\text{C}$, 5 sec. max. with 2% silver bearing solder.	Appearance: No Damage ΔC : COG= $\pm 0.25\text{pF}$ or $\pm 2.5\%$ (whichever is greater). X7R= $\pm 7.5\%$ max. Z5U $\pm 20\%$ max. Y5V= $\pm 20\%$ max. After 48 ± 4 hour period, parts should satisfy all initial requirements for D.F., I.R., and Flash Voltage ($2.5 \times \text{WV}$). (500V= $2 \times \text{WV}$). 25% max. leaching on each edge.
Vibration	MIL-STD-202 method 204C condition B 10-2,000 Hz, 15 G's	Appearance: No Damage Initial value guarantee
Shock	MIL-STD-202 method 213C condition I	Appearance: No Damage Initial value guarantee

ELECTRICAL

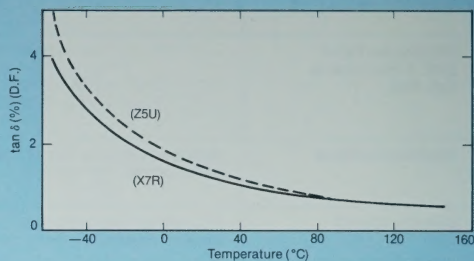
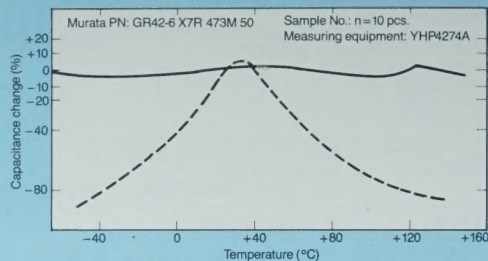
TEST	TEST METHOD	REQUIREMENT
Capacitance (Voltage and Frequency)	COG: over 1,000pF 1Kz±100Hz, 1±0.2Vrms under 1,000pF 1MHz±100KHz, < 5Vrms X7R: 1KHz±100Hz, 1±0.2Vrms Z5U/Y5V: 1KHz±100Hz, .5V, ±.1Vrms	
Q/Dissipation Factor (Volt. & Freq. same as Cap. Test)	COG: (less than 30pF), Q ≥ 400+(20 × Cap. (pF)) @25°C (30pF and over), Q ≥ 1,000 @25°C X7R: D.F.=2.5% max. @25°C Z5U: D.F.=3.0% max. @25°C Y5V: D.F.=3.5% max. @25°C	
Insulation Resistance	Apply rated voltage for max. of 2 min. with 50mA limiting current.	COG, X7R: 100,000MΩ or 1,000MΩ · μF (whichever is less). Z5U, Y5V: 10,000MΩ or 500MΩ · μF (whichever is less).
Dielectric Strength	2.5 × WV for 5 sec. with a series resistor limiting the charging current to 50mA max. (500V=WV×2)	No dielectric breakdown

ENVIRONMENTAL

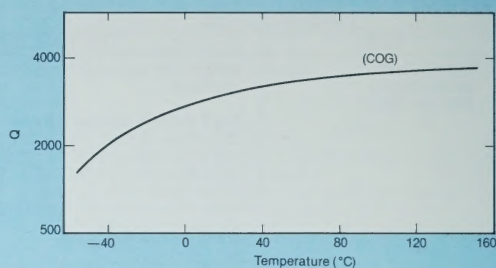
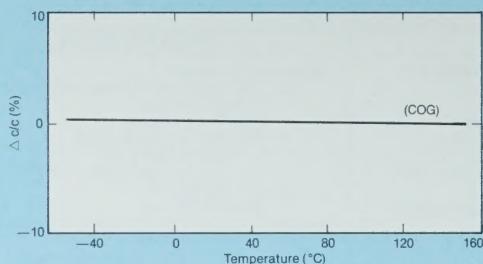
TEST	TEST METHOD	REQUIREMENT
Thermal Shock and Immersion* (RPE Type Only)	MIL-STD-202, method 107, condition A and method 104, condition B. Step 1. Parts are subjected to 5 cycles of the following: COG, X7R=−55°C (30 min.)→25°C (10 15 min.) →125°C (30 min.)→25°C (10 15 min.) Z5U, Y5V=−30°C (30 min.)→25°C (10 15 min.)→85°C (30 min.)→25°C (10 15 min.) Step 2. Parts are placed in a water bath and then subjected to 2 cycles of the following: 65°C±5°C −0°C (15 min.) 0°C±3°C (15 min.)	Appearance: No Damage ΔC: COG=±5% or ±0.5pF max. (whichever is greater) X7R=±12.5% max. Z5U/Y5V=±30% max. Q: COG=30pF and greater ≥ 350; 10pF to 30pF ≥ 275; Less than 10pF ≥ 200 DF: X7R=5% max. Z5U/Y5V=5% max. Insulation Resistance: COG=50,000MΩ or 500MΩ · μF (whichever is less) X7R=50,000MΩ or 500MΩ · μF (whichever is less) Z5U/Y5V=5,000MΩ or 250MΩ · μF (whichever is less)
Humidity	Parts are subjected to a temperature of 40±2°C with 90-95% RH for 500 ⁺²⁴ ₋₀ hours.	Appearance: No Damage ΔC: COG=±3% or ±0.3pF max. (whichever is greater) X7R=±12.5% max. Z5U/Y5V=±30% max. Q: COG=30pF and greater ≥ 350; 10pF to 30pF ≥ 275; Less than 10pF ≥ 200 DF: X7R=3% max. Z5U/Y5V=5% max. Insulation Resistance: COG=50,000MΩ or 500MΩ · μF (whichever is less) X7R=10,000MΩ or 500MΩ · μF (whichever is less) Z5U/Y5V=5,000MΩ or 250MΩ · μF (whichever is less)
Load Humidity Life (RPE type only)	Parts are subjected to a temperature of 40±2°C with 90-95% RH for 500 ⁺²⁴ ₋₀ hours. Rated voltage is applied.	Same as humidity.
High Temperature Life	Parts are subjected to their max. operating temperature ±3°C with 2 x rated voltage for 1,000 ⁺⁴⁸ ₋₀ hours.	Appearance: No Damage ΔC: COG=±5% or ±0.5pF max. (whichever is greater) X7R=±12.5% max. Z5U/Y5V=±30% max. Q: COG=30pF and greater ≥ 350; 10pF to 30pF ≥ 275; Less than 10pF ≥ 200 DF: X7R=3% max. Z5U/Y5V=5% max. Insulation Resistance: COG=10,000MΩ or 100MΩ · μF (whichever is less) X7R=10,000MΩ or 100MΩ · μF (whichever is less) Z5U/Y5V=1,000MΩ or 50MΩ · μF (whichever is less)
Barometric Pressure	MIL-STD-202 method 105C condition D (100K ft) 100% rated voltage applied for 5 seconds, current limited to 50mA	Appearance: No Damage Initial value guarantee

TYPICAL PERFORMANCE CHARACTERISTICS

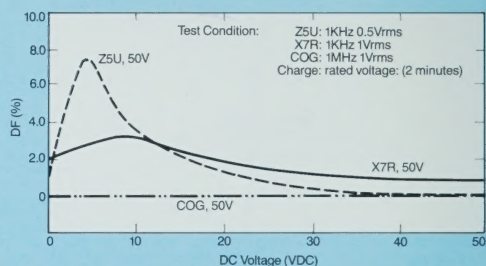
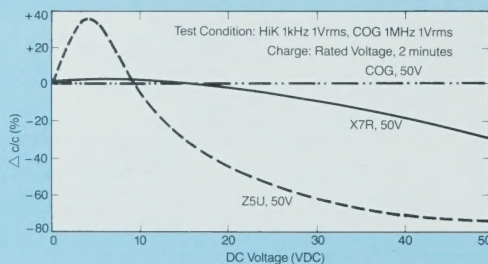
TEMPERATURE VS. CAPACITANCE AND DISSIPATION FACTOR: X7R, Z5U



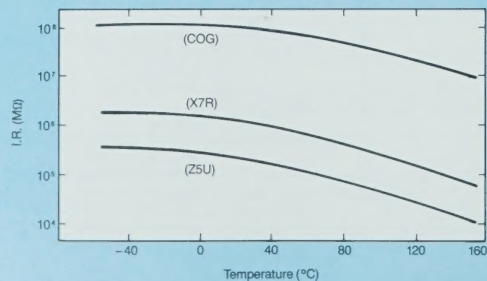
TEMPERATURE VS. CAPACITANCE AND Q: COG (NPO)



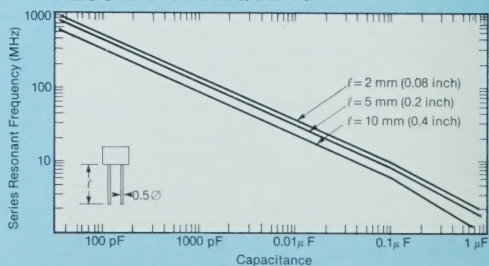
DC VOLTAGE VS. CAPACITANCE AND DISSIPATION FACTOR



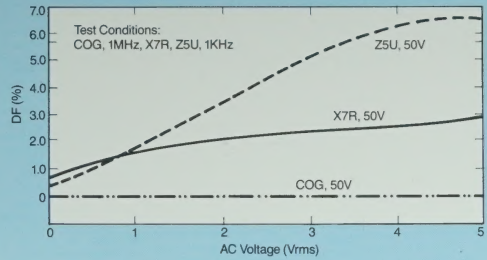
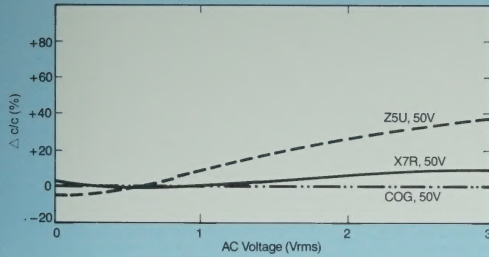
TEMPERATURE VS. INSULATION RESISTANCE



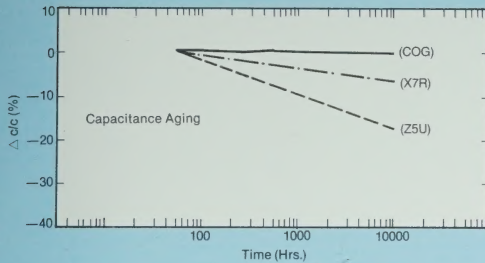
CAPACITANCE VS. SERIES RESONANT FREQUENCY



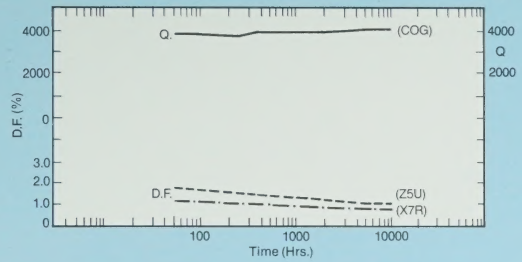
AC VOLTAGE VS. CAPACITANCE AND DISSIPATION FACTOR



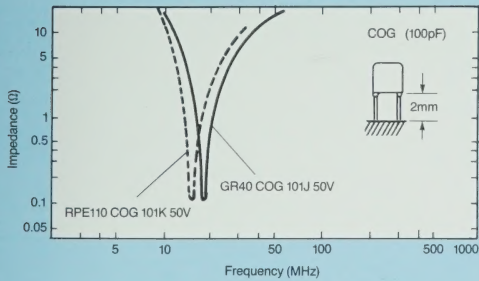
CAPACITANCE VS. TIME (Aging)



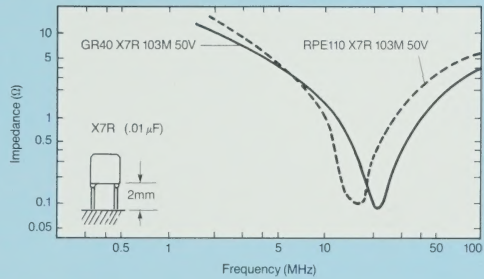
DISSIPATION FACTOR AND Q VS. TIME (Aging)



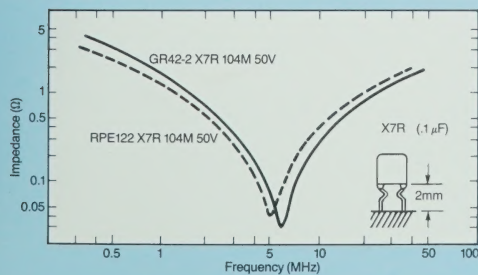
IMPEDANCE VS. FREQUENCY



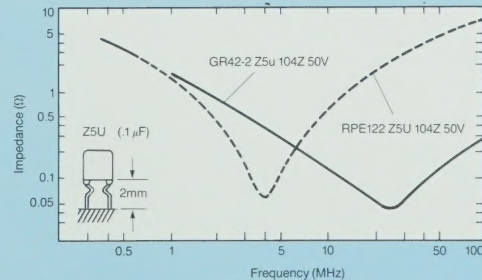
IMPEDANCE VS. FREQUENCY



IMPEDANCE VS. FREQUENCY



IMPEDANCE VS. FREQUENCY





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